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DATE: March 23, 2011

SUBJECT: REVIEW OF RAVEN FILM PERMEABILITY TESTS

This review utilizes the following eleven documents:

1. Qian, Yaorong and Alaa Kamel. 2010. Memorandum to Jeffrey Dawson and John E. Leahy on "Agricultural tarp permeability to fumigants" dated June 17, 2010.
2. Qian, Yaorang, Alaa Kamel, Chuck Stafford, Thuy Nguyen and Scott Yates. (undated) Film Permeability Determination Using Static Permeability Cells
3. Qian, Yaorong. 2011a. E-mail to Husein Ajwa on "Re: Inter-laboratory validation of film permeability for ASTM" dated February 3, 2011.
4. Qian, Yaorong. 2011b. E-mail to Bruce Johnson on "RE: Permeability testing" dated February 9, 2011.

5-10. Six documents of the form Ravenx.pdf, with x=1,2,3,4,5,6, each of which is a computer printout from the FilmPC program developed by Scott Yates for analyzing film permeability.

11. Johnson, Bruce. 2011. Memorandum to Randy Segawa on STUDY REQUIREMENTS FOR FILM PERMEABILITY MEASUREMENTS dated March 4, 2011.

Table 1. PCFilm results summary for Raven 1.0 mil clear TIF.

Source file	Humidity	MTC (cm/h)	Average (cm/h)	SD (cm/h)	Length of trial (h)
Raven1.pdf	amb	0.0000			215
Raven2.pdf	amb	0.0000			215
Raven3.pdf	amb	0.0000	0.0000	0.0000	215
Raven4.pdf	high	0.0139			336
Raven5.pdf	high	0.0115			336
Raven6.pdf	high	0.0093	0.0116	0.0023	336

The film type was described as "Raven Industrial VaporSafe 1.0 mil Clear TIF" (Qian 2011a). The six permeability tests consisted of three tests at high humidity and three at ambient humidity

(Table 1). The tests were conducted by the U.S. Environmental Protection Agency under the protocol described by Qian et al. (undated, listed above).

A point by point comparison of the draft protocol and study follow this. Dr. Qian provided the Method Detection Limit (MDL) for methyl iodide: 2.1 ng/mL (Qian 2011b).

Based on this comparison, the permeability studies for Raven Industrial VaporSafe 1.0 mil clear TIF are adequate for determination of MTC. Since the average MTC under ambient conditions is < 0.02 cm/h, this tarp meets the requirements for a high barrier tarp for use with iodoemethane.

1. Test method and test conditions a. General descriptions provided in Papiernik et al. (2001, 2002, 2010). A more detailed methodology presented in Qian et al. (undated). b. Temperatures 20-25 C c. Two humidity conditions i. Source cell humidity < 45%, receiver cell humidity < 45% ii. Source cell humidity > 90%, receiver cell humidity <45% 1. Papiernik et al. (2010) describes humidity modifications d. Study duration i. Until reaching one of the following 1. 7 days 2. Cr/Cs=0.95 e. Sampling frequency i. Structured to sample more intensively at the beginning where the fastest concentration change will occur f. Three replicates per humidity condition i. A single film will require six determinations ii. Replications in three physically different cells g. Analysis using “Film Permeability Analysis” FilmPC as provided by SR Yates	1. Test method and conditions a. OK b. Qian email 25C c. OK i. 30-40% June 17 memorandum ii. June 17 memorandum d. 215h OK e. OK f. OK g. OK

2. Reporting requirements a. Cell dimensions and location of ports b. Spiking procedure – enough information to calculate the initial concentration c. Initial concentrations (actual concentrations as mass/volume) i. Measured initial concentration ii. Theoretical initial concentration (based on spiking procedure) d. Method of gas analysis e. Detection limit for analysis f. Measured time course of concentrations in source and receiving chambers g. Results of analysis using PC FILM software i. Plot of measured values versus model solution ii. Estimates for h (mass transfer coefficient), h. Conditions i. Laboratory temperature ii. Laboratory humidity iii. Source cell humidity 1. describe how determined i. Tarp information i. Name ii. Manufacturer iii. Thickness iv. Color v. Color digital photographs of film 1. from 2 meters away 2. from 20 cm away vi. Is film embossed j. Sample instrument linearity determinations i. Frequency of linearity determinations in relation to	2. Reporting a OK b OK – EPA protocol c OK d OK e OK Qian 2/9/11 e-mail 2.1 ng/ml f OK g OK h OK i Tarp info i OK ii OK iii OK – 1 mil iv OK v No vi OK? j Linearity is checked, but no specific results